



An Overview of the Burden of Non- Communicable Diseases in India

***R Prakash Upadhyay**

Center for Community Medicine, Old OT Block, All India Institute of Medical Sciences, Ansari Nagar, New Delhi, India

(Received 24 Jun 2011; accepted 12 Dec 2011)

Abstract

Non-communicable disease continues to be an important public health problem in India, being responsible for a major proportion of mortality and morbidity. Demographic changes, changes in the lifestyle along with increased rates of urbanization are the major reasons responsible for the tilt towards the non-communicable diseases. In India, there is no regular system for collecting data on non-communicable diseases (NCDs) which can be said to be of adequate coverage or quality. Lack of trained health care workers, primary care providers armed with inadequate knowledge and skills along with ill-defined roles of various health sectors i.e. public, private, and voluntary sectors in providing care have played key hurdles in combating the growing burden of non-communicable diseases. Empowerment of the community through effective health education, use of trained public health personnel along with provision of free health care and social insurance would prove beneficial in effectively controlling the growing prevalence of NCDs.

Keywords: Non-communicable diseases, Cardiovascular diseases, Burden, India

Introduction

Industrialization, socio-economic development, urbanization, changing age structure, changing lifestyles has placed India at a position where it is facing a growing burden of non-communicable diseases. In India, non-communicable diseases (NCDs) accounted for 40% of all hospital stays and 35% of all outpatient visits in 2004 (1). Also, chronic diseases are estimated to account for 53% of all deaths and 44% of disability-adjusted life-years (DALYs) lost in 2005(2). As of 2005, India experienced the “highest loss in potentially productive years of life” worldwide (3).

The four leading chronic diseases in India, as measured by their prevalence, are in descending order: cardiovascular diseases (CVDs), diabetes

mellitus, chronic obstructive pulmonary disease (COPD) and cancer. All four of these diseases are projected to continue to increase in prevalence in the near future (4). The projected cumulative loss of national income for India due to non-communicable disease mortality for 2006-2015 is expected to be USD237 billion. By 2030, this productivity loss is expected to double to 17.9 million years lost (5). In India, there is no regular system for collecting data on non-communicable diseases (NCDs)-which can be said to be of adequate coverage or quality. Thus, most of these estimates at best may be taken as approximation only.

Non- communicable diseases (NCDs) mainly include:

- Cardiovascular diseases
- Stroke
- Diabetes Mellitus
- Cancer
- Chronic Lung diseases
- Accidents and Injuries

Cardiovascular diseases

Ischemic heart disease (IHD) is the leading cause of death in economically developed countries and is rapidly assuming serious dimensions in developing countries. It is expected to be the single most important cause of death in India by the year 2015 A.D (6). According to the WHO,

an estimated 17 million people died from cardiovascular disease (CVD) in 2005 comprising 30% of all global deaths and of these nearly 80% of deaths took place in low and middle income countries like India (7). According to the World Heart Federation, 35% of all CVD deaths in India occur in those aged 35-64 years (8). Coronary heart disease (CHD) is the commonest CVD accounting for 90-95% of all cases and deaths. Further, as can be seen from Table 1, there has been a considerable increase in the number of cases of IHD as well as the deaths due to it. Also, the observed increase is both in urban as well as rural areas.

Table 1: Burden of Ischemic heart disease in India

Year	1998			2004		
	Urban	Rural	Total	Urban	Rural	Total
Number of cases of IHD	9,210,381	9,390,559	18,600,940	11,674,208	10,693,632	22,367,840
Number of deaths due to IHD	207,548	256,014	463,562	255,782	298,412	554,194
Number of YLLs	1,991,451	2,470,149	4,461,600	2,329,851	2,622,299	4,952,150
Number of DALYs	7,388,453	6,930,974	14,319,427	8,643,450	7,357,358	16,000,808

Source: *Assessment of Burden of Non-Communicable Diseases, Indian Council of Medical Research 2006*

Stroke

In India, stroke incidence registries using population-based surveillance have reported that age adjusted annual incidence of stroke varies from 100- 150/100,000 population (9). The increase in CHD and stroke in India is largely an urban phenomenon. In 2005, estimates indicated that 58 million people died, and in them chronic diseases accounted for nearly 35 million deaths (60%). Cardiovascular diseases, predominantly heart disease and stroke, were the cause of death

in 17.5 million individuals. After heart disease, stroke is the second leading single cause of death, with 5.8 million fatal cases per year, 40% of which are in people younger than 70 years (10). Approximately 12% of all strokes occur in the population <40 years of age. There has been an increase in the number of stroke cases in India during the last one and a half decades by 17.5 %. Mortality due to strokes has increased by 7.8% from 1998 to 2004 (Table 2) (10).

Table 2: Burden of stroke in India

	1998	2004
Number of cases of stroke	7,926,28	9,30,985
Number of deaths	5,93,362	6,39,455
Number of YLL	48,18,740	52,89,357
Number of DALY	58,02,295	63,68,970

Source: *Assessment of Burden of Non-Communicable Diseases, Indian Council of Medical Research 2006*

Diabetes Mellitus

India is currently experiencing an epidemic of Type 2 diabetes mellitus (T2DM) and has the largest number of diabetic patients. It is often referred to as the diabetes capital of the world (11). International Diabetes Federation (IDF) 2009 report reveals that the total number of diabetic subjects in India is 50.8 million (12).

In a study conducted as a part of the National non-communicable diseases (NCD) risk factor surveillance, in different geographical locations (North, South, East, West/Central) in India, where major risk factors were studied using modified WHO STEPS approach and diabetes was diagnosed based on self-reported diabetes diagnosed by a physician, found that the overall prevalence of self-reported diabetes was highest in Trivandrum in Kerala (9.2%), followed by Chennai in Tamilnadu (6.4%) and Delhi (6.0%). This was followed by Ballabgarh in North India (2.7%), Dibrugarh in East India (2.4%) and the lowest was observed in Nagpur in West/Central India (1.5%) (13).

The Prevalence of Diabetes in India Study (PODIS) was carried out in 2004, in 108 centres (49 urban and 59 rural) in different parts of India to look at the urban-rural differences in type 2 diabetes and glucose intolerance (14,15). The prevalence of diabetes in the rural areas according to WHO criteria and American Diabetes Association (ADA) criteria was 2.7% and 1.9% respectively. Compared to that, the prevalence have enormously increased in the present scenario with studies from rural Kerala and Andhra Pradesh, reporting a prevalence as high as 12.5 % and 13.2% respectively (16,17). Largely, Southern states have a more prevalence than Northern states. Misra P et al analyzed the secular trends of diabetes in rural India and documented an increase in diabetes prevalence among rural population at a rate of 2.02 per 1000 population per year. The rate of increase was high in males (3.33 per 1000 per year) as compared to females (0.88 per 1000 per year) (18).

Cancer

Nearly 56% of the estimated deaths from cancer occur in the developing world (19). The estimates of burden of disease due to cancer are based on data of population based cancer registries of ICMR for the year 2004. The pooled data of six population based cancer registries – Bangalore, Barshi, Bhopal, Chennai, Delhi and Mumbai was used in estimating indices of burden of disease. The six population based cancer registries cover a population of 34 million that is, 18.4 million males and 15.6 million females. The number of cases of cancer in 2004 was approximately 8.2 lakh. The number of cancer cases among males being around 3.9 lakh, and among females was 4.3 lakh (19).

Tobacco related cancers constituted 40.43 % of all cancers in males. Among females, high incidence rates were reported for breast cancer (20.01 / 100,000), cervix (14.42 / 100,000), ovary (5.6 / 100,000) which together accounted for 59 % of all cancers in women (19). In India, the most prevalent forms of cancer among men are tobacco-related cancers including lung, oral, larynx, esophagus, and pharynx. Amongst Indian women, in addition to tobacco-related cancers, cervix, breast, and ovarian cancers are also prevalent. India currently has the highest prevalence of oral cancer cases in the world as a result of the popularity of chewing tobacco in its rural regions (3).

Chronic Lung Diseases

Recent estimates from India suggest that in 2005 chronic diseases accounted for 53% of all deaths and 44 % of DALYs lost, with chronic respiratory disease accounting for 7% deaths and 3% DALYs lost (2). According to the National Family Health Survey (NFHS 3), the prevalence of asthma was 1,600 persons / 100,000 (20). It is estimated that there are more than 12 million adults with COPD in India with prevalence rates varying depending upon the population studied and the methodology used. In males the prevalence varies from 2.12% to 9.4% in north India

and from 1.4% to 4.08% in south India. Similar patterns are reported in women, with lower rates in the south. The prevalence amongst women is consistently lower than in men (2). Table 3 shows that the prevalence of chronic obstructive

pulmonary disease (COPD) has consistently been more in males compared to females and also that over the years the prevalence has largely remained unchanged in females.

Table 3: Prevalence of COPD- changes over the years (%)

Period	Males	Females
Up to 1970	4.2	2.7
1971–1990	5.7	2.6
After 1990	4.9	2.7
Average	5.0	2.7

Source: Murthy and Sastry. NCMH Background papers- Burden of disease in India

Accidents and Injuries

The National Crime Records Bureau (NCRB) is the principal nodal agency under the Ministry of Home Affairs, Government of India, and is responsible for the collection, compilation, analysis and dissemination of injury-related information. The injury mortality rate was 40/100,000 population during 2000 (21). The number of deaths due to accidents increased by 47% during the period 1990–2000; 93% were due to unnatural causes and 7% (17,366) due to natural causes. The mortality rate among differ-

ent age groups was: 8.2% (<14 years), 62% (15–44 years), 20% (45–59 years) and 9.2% (>60 years). Seventy three per cent of total deaths occurred among men, with a ratio of 3:1 between men and women (22, 23). Table 4 shows the incidence of deaths, sub-grouped into natural and un-natural, due to accidents for a period of seven years. The key thing to note is that the incidence of un-natural accidental deaths has always been in excess, compared to natural deaths.

Table 4: Incidence of deaths due to accidents in India (2002-2008)

Causes	2002	2003	2004	2005	2006	2007	2008
Natural	16723	14954	18937	22415	21502	25153	23993
Un- natural	243399	244671	258326	271760	293202	315641	318316

Source: Accident Deaths and suicides in India report, National Crime Records Bureau, Ministry of Home Affairs

Selected Risk Factors for NCDs

The major risk factors for non-communicable diseases are smoking, alcohol abuse, a sedentary lifestyle, and an unhealthy diet. If these could be addressed adequately, 40-50% of non-communicable disease-related, premature deaths are preventable (4).

Tobacco use

The prevalence of tobacco use, in smoked and smokeless forms, has been estimated in the National Sample Survey and the National Family Health Survey (NFHS). According to the NFHS-

3 report, the prevalence of smoking in men and women aged 15-49 was 32.7 % and 1.4% respectively. In context of using tobacco in any form, the prevalence in males and females was 57% and 10.8% respectively (24). Among youth, 40 percent of men and 5 percent of women use tobacco. Nineteen percent of men report smoking cigarettes or bidis and 30 percent report consumption of pan masala, gutkha, or other tobacco products (25). In the Indian component of the Global Youth Tobacco Survey (2000–04), 25.1% of the students aged 13–15 years reported

that they had ever used tobacco, whereas current use was reported by 17.5%.

Alcoholism

Pattern of alcohol consumption varies with geographical location. Punjab, Andhra Pradesh, Goa and north-eastern states have a much higher proportion of male alcohol consumers than the rest of the country. Women tend to drink more in the states of Arunachal Pradesh, Assam and Sikkim (20). In India, the estimated numbers of alcohol users in 2005 were 62.5 million, with around 17% of them, which translates into 10.6 million, being dependant users (26). Usually 20-30% of hospital admissions are due to alcohol-related problems (27). According to NFHS-3, 35 percent of ever married males report consumption of alcohol. In Arunachal Pradesh, Mizoram, Meghalaya, Chhattisgarh, and Tripura one-third or more young men consume alcohol. Alcohol consumption among male youth is highest in Chennai, at 29 percent and lowest in Indore, at 13 percent. Alcohol consumption is much higher in slum areas of Meerut, Indore, Mumbai, Nagpur, and Chennai (25).

Obesity and physical activity

Overweight is more prevalent among female, urban and high socioeconomic status (SES) groups (28). The prevalence of overweight and obesity had increased slightly over the past decade in India, but in some urban and high-SES groups it reached a relatively high level. A large multiple-site survey conducted in 10 industries in urban areas reported a high combined prevalence (BMI ≥ 25) of 30.9% (29). Another survey conducted in six major cities (Chennai, Bangalore, Hyderabad, Calcutta, Mumbai and New Delhi) showed that the combined prevalence of overweight and obesity was 30.8% and that of central obesity (waist-hip ratio ≥ 0.90 in men and ≥ 0.85 in women) was 50.3% (30).

On comparing National Family Health Survey (NFHS)-2 (1998-99) with NFHS-3 (2005-06) report, the prevalence of overweight in females increased from 5.9% to 7.4% and of obesity

from 0.9% to 1.3% (20, 31). The National Nutrition Monitoring Bureau (NNMB) data for adults also showed a moderate increase in the combined prevalence of overweight and obesity between 2000-2001 and 2005-2006 among men (5.7% to 7.8%) and women (8.2% to 10.9%) in the rural population (32,33). In a study by Ramachandran et al on temporal changes associated with pattern of life style (1989-2003) there had been a decline in levels of physical activity. The regular use of motorized vehicles increased from 86.6% to 93.4% whereas the percentage of people watching television regularly increased to 70.1% from the baseline value of 57.2% in 1989. Moreover, fewer subjects were engaged in manual work (22.8% in 2003 vs. 80% in 1989) (34).

Economic burden of NCDs

Although there are some literature relating to the economic impact of NCDs in India yet there is a dire need for more methodologically sound research and quality management system to report the economic burden incurred by the general population and the government bodies in context of NCDs. With demographic transition on its way and with evidence that the people in general are at heightened risk of acquiring NCDs owing to change in eating habits, decrease in physical activity, high rates of smoking and tobacco use and increased rate of urbanization, it becomes necessary to understand and gather information on the economic impact due to non-communicable diseases.

There has been an increase of nearly 50% in the out of pocket expenditure for NCDs i.e. from 31.6 percent in 1995-96 to 47.3 percent in 2004 with the major portion of the money used for purchasing of medicines, diagnostic tests and medical equipments (35). It is estimated that in Kerala, a southern Indian state, the economic burden due to cardiovascular disease (CVD) is around 20% of the state domestic product (GDP) (36). The Economist Intelligence Unit (EIU, 2007) estimated the economic costs of the di-

abetes epidemic in 4 countries, including India. Direct medical care costs, productivity loss due to mortality, morbidity and disability associated with diabetes were taken into account. Their estimates of the costs for India were about 2.1 percent of GDP (37). Besides this, there are a number of small studies focusing on the costs of treating diabetes in India. Shobhana et al. estimated the out-of-pocket spending by a sample of about 600 diabetic in-patients in Chennai. As per their estimate, the average expenditure during hospitalization was about Rupees 5,300. The diabetics who reported a longer history of diabetes (≥ 5 years) spent 70 percent more during their hospitalization as compared to those with a recent history of diabetes (38).

Ironically few studies provide economic analyses of the impact of chronic obstructive pulmonary disease (COPD) and asthma in India. To come to an estimate, Murthy et.al projected future populations with COPD assuming no change in prevalence rates over time and no change in urbanization patterns. These projections were combined with simple forecasts of the future costs of treating various cases of COPD to arrive at the aggregate national health care costs of COPD which came out to be Rupees 483 billion in 2016 (39). There does not appear to be much information available on the economic impact of cancers in India. Gumber (1995) estimated the cost involved in treating injuries both in public and private hospitals in India in five Indian states – Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal, using data from the National Sample Survey round of 1986-87 (40). The average out-of-pocket expenditure for hospitalization in private hospitals ranged from INR 621 in West Bengal to INR 6,034 in Gujarat. If we use these baseline values for the year 1986-87 and extrapolate to the year 2010 using the inflation rate for 2010, we find that the expenditure will amount to INR 3321.24 and INR 32,271.22 respectively. Similarly, in the two states Gumber found that public hospitals were somewhat cheaper with spending on injury-related medical care ranging from INR

324 to INR 1,740 in the two states respectively. This will amount to approximately INR 1732.82 and INR 9305.94 respectively for the year 2010.

Conclusion

India is experiencing a rapid health transition with the problem of both malnutrition and over nutrition. India must orient the health system towards prevention, screening, early intervention and new treatment modalities with the aim to reduce the burden of chronic disease. Surveillance of NCDs and their risk factors should also become an integral function of health systems. Evidence based clinical practice and appropriate use of technologies should be promoted at all levels of health care, including tertiary services. Keeping in view that chronic diseases have an impact on the health and productivity of the people, these measures are essential for the health of India as well as its economic progress.

Ethical Considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

Acknowledgments

I would like to acknowledge Dr. Palanivel C, Dr. Vaman Kulkarni and Dr. Kalaiselvi for their help during the preparation of this manuscript. For the preparation of the current manuscript no funding was required. The authors declare that there is no conflict of interests.

References

1. Mahal A, Karan A, Engalgau M (2009). The Economic Implications of Non-Communicable Disease for India, Washington DC: The International Bank for Reconstruction and Development/The World Bank :xiv

2. ICMR-MRC Workshop. Building Indo-Uk collaboration in chronic diseases.2009; p.16
3. Reddy KS, Shah B, Varghese C, Ramadoss A (2005). Responding to the threat of chronic diseases in India. *The Lancet*, 366: 1746-51.
4. Taylor DW. The Burden of Non-Communicable Diseases in India, Hamilton ON: The Cameron Institute, 2010.p.13.
5. World Health Organization, Chronic Disease Report, 2005.
6. Shah B, Narendra K, Geetha R, Khurana S, Kumar H. Assessment of burden of non-communicable diseases.p.5.
7. Available:
http://www.who.int/nmh/publications/fact_sheet_cardiovascular_en.pdf, accessed on 10.06.2011
8. Fuster V, Voute J. "MDGs: chronic diseases are not on the agenda" (2005). *The Lancet*, 366: 1512-14.
9. ICMR-MRC Workshop. Building Indo-Uk collaboration in chronic diseases.2009; p.8.
10. Shah B, Prashant M. Workshop report on stroke surveillance in India.p.1.
11. International Diabetes Federation (2006). Diabetes atlas. 3rd edition. International Diabetes Federation, Brussels
12. Available from: <http://www.idf.org/latest-diabetes-figures-paint-grim-global-picture>, accessed on 16 .06. 2011
13. Mohan V, Mathur P, Deepa R, Deepa M, Shukla DK , Menon GR, Anand K, Desai NG, Joshi PP, Mahanta J, Thankappan KR, Shah B (2008). Urban rural differences in prevalence of self-reported diabetes in India—The WHO-ICMR Indian NCD risk factor surveillance. *Diab Res Clin Pract*, doi:10.1016/j.diabres.2007.11.018.
14. Sadikot SM, Nigam A, Das S, Bajaj S, Zargar AH, Prasannakumar KM, Sosale A, Munichoodappa C, Seshiah V, Singh SK, Jamal A, Sai K, Sadasivrao Y, Murthy SS, Hazra DK, Jain S, Mukherjee S, Bandyopadhyay S, Sinha NK, Mishra R, Dora M, Jena B, Patra P, Goenka K (2004). The burden of diabetes and impaired glucose tolerance in India using the WHO 1999 criteria: prevalence of diabetes in India study (PODIS). *Diabetes Res Clin Pract*, 66:301-07.
15. Sadikot SM, Nigam A, Das S, Bajaj S, Zargar AH, Prasannakumar KM, Sosale A, Munichoodappa C, Seshiah V, Singh SK, Jamal A, Sai K, Sadasivrao Y, Murthy SS, Hazra DK, Jain S, Mukherjee S, Bandyopadhyay S, Sinha NK, Mishra R, Dora M, Jena B, Patra P, Goenka K (2004). The burden of diabetes and impaired glucose tolerance in India using the ADA 1997 criteria: prevalence of diabetes in India study (PODIS). *Diabetes Res Clin Pract*, 66:293-300.
16. Vijayakumar G, Arun R, Kutty VR (2009). High prevalence of type 2 diabetes mellitus and other metabolic disorders in rural central Kerala. *J Assoc Physicians India*, 57:563-67.
17. Chow CK, Raju PK, Raju R, Reddy KS, Cardona M, Celermajer DS, Neal BC (2006). The prevalence and management of diabetes in rural India. *Diabetes Care*, 29:1717-18.
18. Misra P, Upadhyay RP, Misra A, Anand K (2011). A review of the epidemiology of diabetes in rural India. *Diabetes Res Clin Pract*, 92(3):303-11.
19. Anonymous. Available:
http://www.whoindia.org/linkfiles/assessment_of_burden_of_ncd_07-cancer.pdf, accessed on 22.06. 2010
20. IIPS and Macro International. National Family Health Survey (NFHS-3), 2005–06: India. International Institute for Population Sciences: Mumbai, 2007.
21. National Crime Records Bureau (NCRB), 2000.
22. Gururaj G. Injuries in India: A national perspective. NCMH background papers. Available:
http://whoindia.org/LinkFiles/Commission_on_Macroeconomic_and_Health_Bg_P2_Injury_in_India.pdf, accessed on 25.06.2011.
23. National Crime Records Bureau. Accidental deaths and suicides in India. New Delhi: Ministry of Home Affairs, Government of India; 2001b.
24. National Family Health Survey-(NHFS-3) - India; Volume I, Table 13.10, Page 433 (2005-06), MOHFW/GOI.
25. Parasuraman S, Kishor S, Singh SK, Vaidehi Y (2009). A Profile of Youth in India. National Family Health Survey (NFHS-3), India, 2005-06. Mumbai: International Institute for

- Population Sciences; Calverton, Maryland, USA: ICF Macro.
26. Ray R (2004). National survey on extent, pattern and trends of drug abuse in India. Ministry of Social Justice and Empowerment, New Delhi: Government of India and United Nations Office on Drugs and Crime.
 27. Benegal V, Gururaj G, Murthy P (2002). Project report on a WHO multicentre collaborative project on establishing and monitoring alcohol's involvement in casualties, 2000-01. Bangalore: NIMHANS.
 28. Wang Y, Chen HJ, Shaikh S, Mathur P (2009). Is obesity becoming a public health problem in India? Examine the shift from under- to over nutrition problems over time. *Obes rev*,10:456-74.
 29. Reddy KS, Prabhakaran D, Chaturvedi V, Jemmon P, Thankappan KR, Ramakrishnan L, Mohan BV, Pandav CS, Ahmed FU, Joshi PP, Meera R, Amin RB, Ahuja RC, Das MS, Jaison TM (2006). Methods for establishing a surveillance system for cardiovascular diseases in Indian industrial populations. *Bull World Health Organ*, 84: 461-69.
 30. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, Rao PV, Yajnik CS, Prasanna Kumar KM, Nair JD (2001). High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia*, 44: 1094-1101.
 31. IIPS and ORC Macro. National Family Health Survey (NFHS- 2), 1998-99: India. International Institute for Population Sciences: Mumbai, 2000.
 32. NNMB. Diet and nutritional status of rural population. National Nutrition Monitoring Bureau Technical Report No: 21. 2002. Available from: <http://nnmbindia.org/NNMBREPORT2001-web.pdf>, accessed on 08.07. 2011
 33. NNMB. Diet and nutritional status of population and prevalence of hypertension amongst adults in rural areas. National Nutrition Monitoring Bureau Technical Report No: 24. 2007. Available from: <http://nnmbindia.org/NNMBReport06Nov20.pdf>, accessed 08.07.2011
 34. Ramachandran A, Snehalatha C, Baskar ADS, Mary S, Sathish Kumar CK, Selvam S, Catherine S, Vijay V (2004). Temporal changes in prevalence of diabetes and impaired glucose tolerance associated with lifestyle transition occurring in the rural population in India. *Diabetologia*, 47:860-86.
 35. Mahal A, Karan A, Engelgau M (2010). The economic implications of non-communicable disease for India. HNP Discussion Paper.p.14.
 36. Gupta I, Kandamuthan S, Upadhyaya D (2006). Economic impact of cardiovascular diseases in India (unpublished). New Delhi, India: Institute of Economic Growth, University of Delhi.
 37. Economic Intelligence Unit (2007). The Silent Epidemic: An Economic Study of Diabetes in Developed and Developing Countries. London, United Kingdom: The Economist, Economic Intelligence Unit.
 38. Shobhana R, Rao PR, Lavanya A, Williams R, Vijay V, Ramachandran A (2000). Expenditure on healthcare incurred by diabetic subjects in a developing country – a study from southern India. *Diabetes Res Clin Pract*, 48(1):37-42.
 39. Murthy KJR, Sastry JG (2005). Economic burden of chronic obstructive pulmonary disease. National Commission on Macroeconomics and Health (NCMH) background papers. p. 265-74. Available from: http://whoindia.org/LinkFiles/Commision_on_Macroecomic_and_Health_Bg_P2_Economic_burden_of_chronic_obstructive_pulmonary_disease.pdf, accessed on 11.08.2011
 40. Gumber A (1997). "Burden of injury in India: utilization and expenditure pattern". Working paper no. 88. Boston, MA: Harvard School of Public Health. Available from: www.hsph.harvard.edu/takemi/RP88.pdf, accessed on 11.08.2011